Ch 17 Endocrinology, Part 2

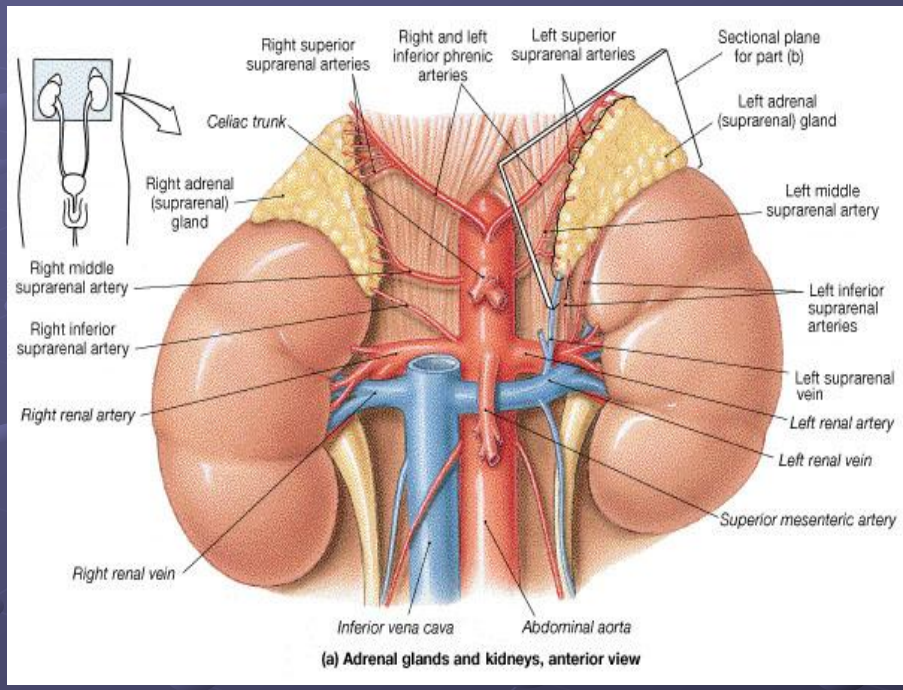
- Adrenal Gland (p 525)
- Steroid hormones and their glands
- Other endocrine glands
- Compare Endocrine and Nervous systems

Developed by
John Gallagher, MS, DVM

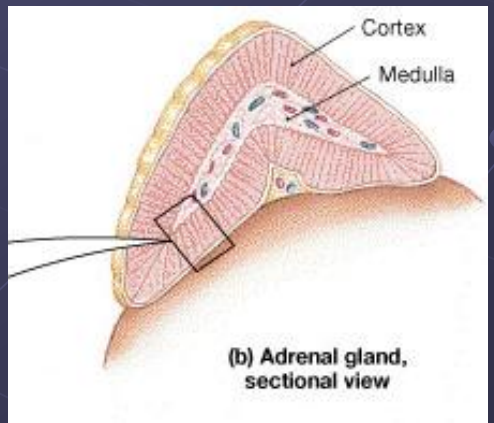
LAS POSITAS COLLEGE

Adrenal (or Suprarenal) Gland

- Adrenal Medulla: modified sympathetic ganglion produces epinephrine and norepinephrine (parallels sympathetic division of ANS)
  - Adrenalin® = adrenaline = epinephrine
  - Neuroendocrine gland



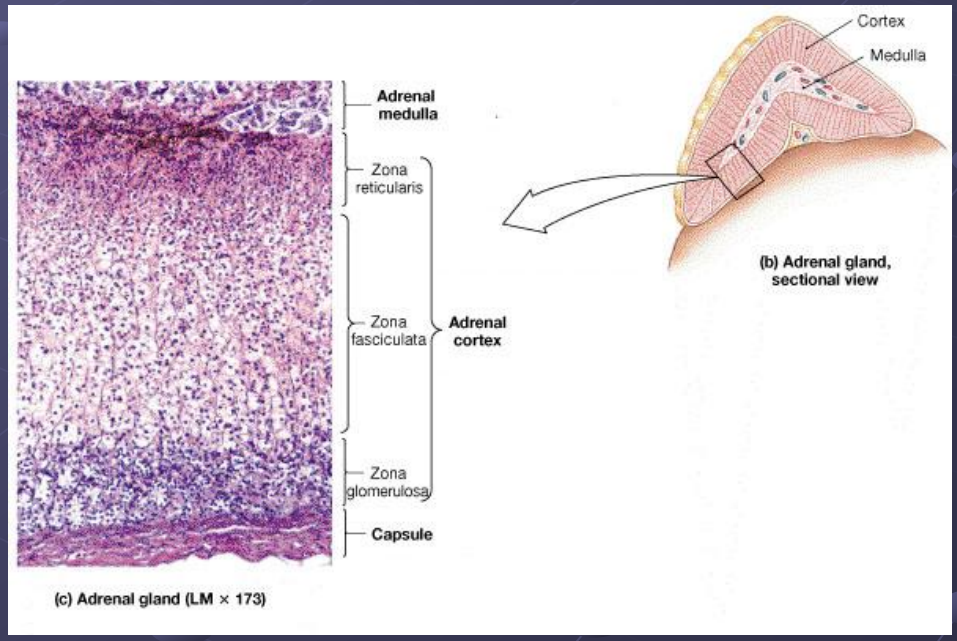
(a) Adrenal glands and kidneys, anterior view



(b) Adrenal gland, sectional view

Adrenal (or Suprarenal) Gland

- Adrenal cortex
  - Corticosteroid production:
    - Zona Glomerulosa—Aldosterone (a mineralocorticoid)
    - Zona fasciculata—Glucocorticoids, esp. cortisol, AKA cortisone
    - Zona reticularis—Androgens? DHEA?



Stress and the Adrenal Gland

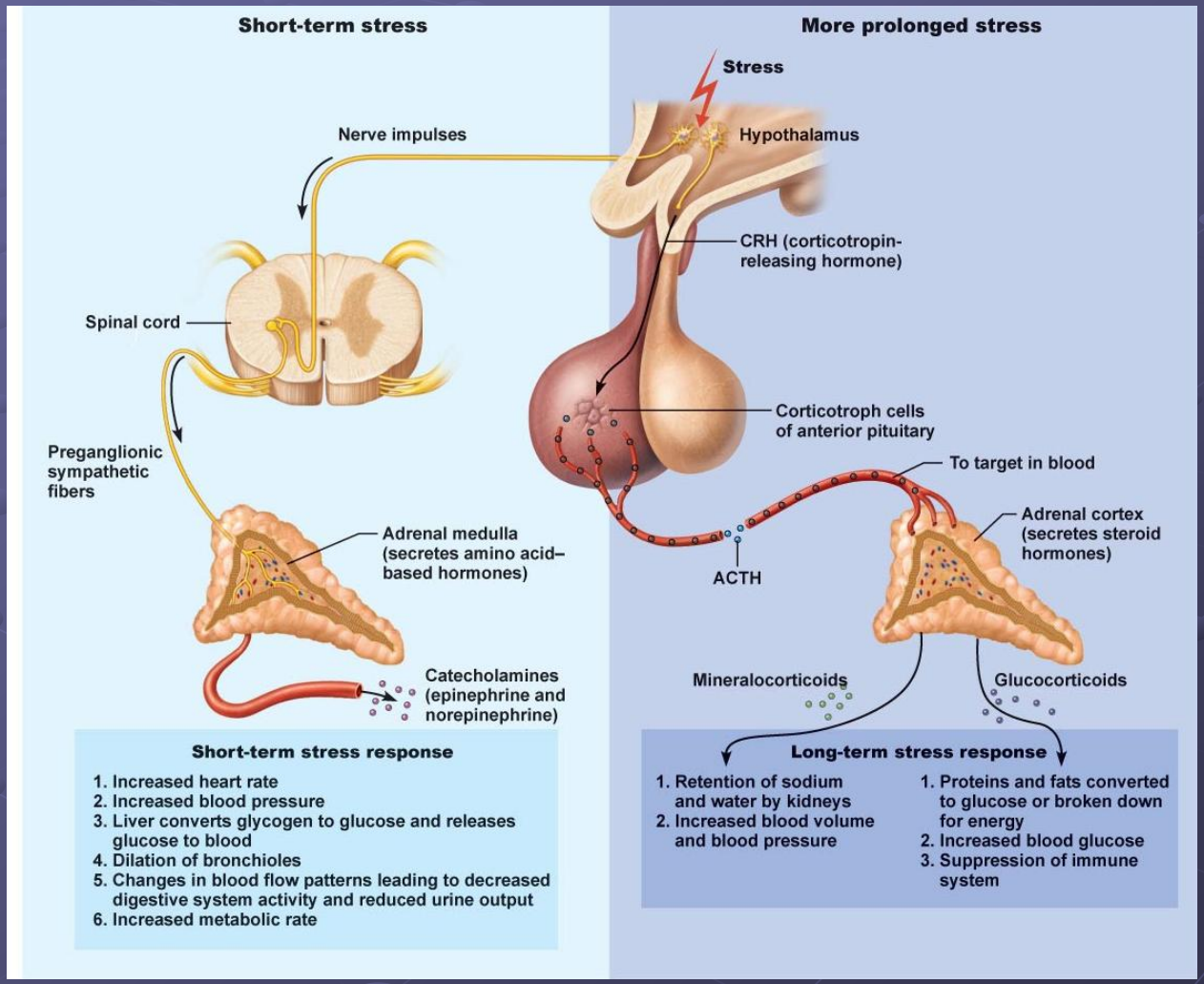
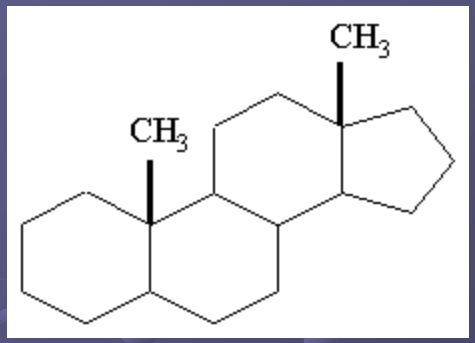
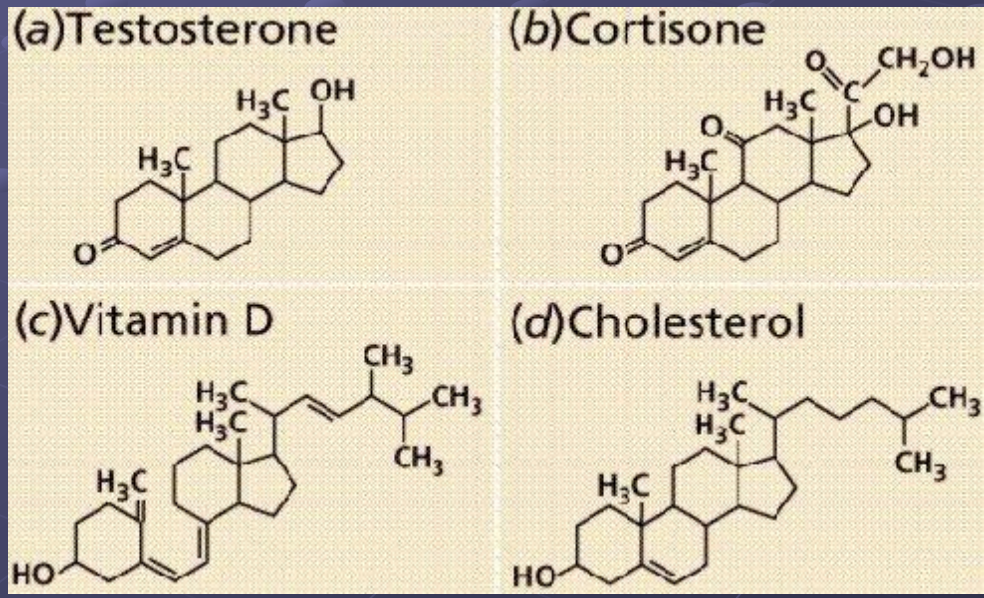

Short-term stress
More prolonged stress
Stress
Nerve impulses
Hypothalamus
CRH (corticotropin-releasing hormone)
Spinal cord
Corticotroph cells of anterior pituitary
Preganglionic sympathetic fibers
To target in blood
Adrenal cortex (secretes steroid hormones)
Adrenal medulla (secretes amino acid–based hormones)
ACTH
Catecholamines (epinephrine and norepinephrine)
Mineralocorticoids
Glucocorticoids
Short-term stress response
1. Increased heart rate
2. Increased blood pressure
3. Liver converts glycogen to glucose and releases glucose to blood
4. Dilation of bronchioles
5. Changes in blood flow patterns leading to decreased digestive system activity and reduced urine output
6. Increased metabolic rate
Long-term stress response
1. Retention of sodium and water by kidneys
2. Increased blood volume and blood pressure
1. Proteins and fats converted to glucose or broken down for energy
2. Increased blood glucose
3. Suppression of immune system

Fig 17.8

Steroid Hormones



- All steroid hormones have a common chemical backbone, derived from cholesterol
- Slight differences in branches decide the hormone's activity
- Lipid soluble
- Estrogen, progesterone, testosterone, cortisol, aldosterone, calcitriol, vitamin D



More Steroids

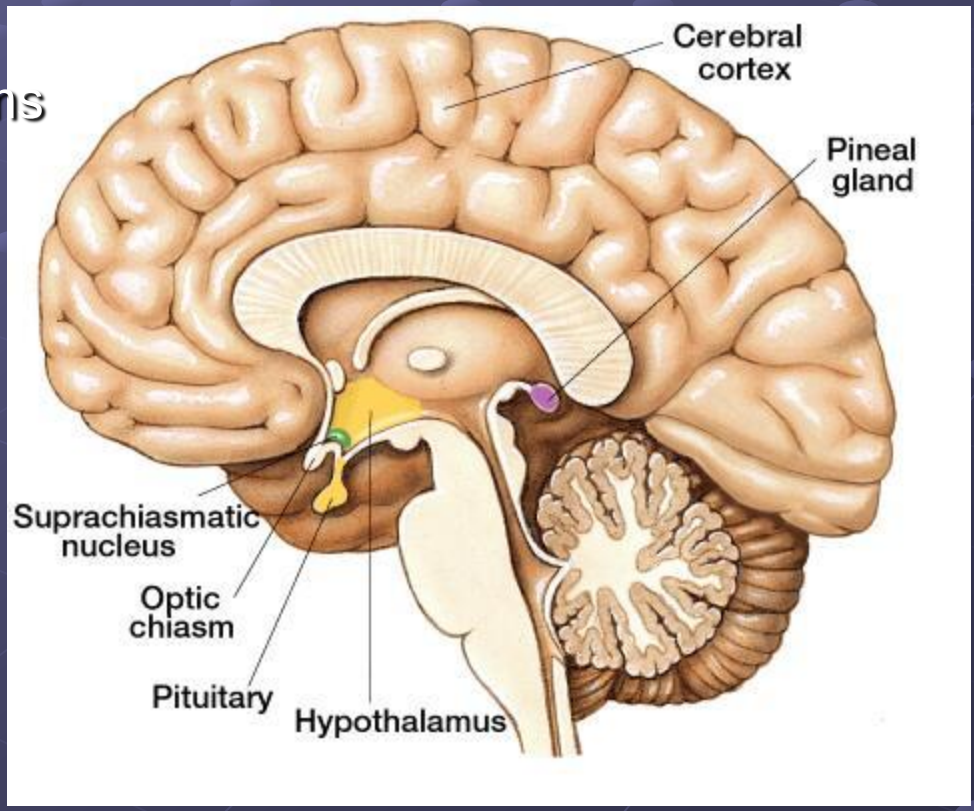
- Sex Steroids
  - Female: estrogen and progesterone
  - Male: testosterone, AKA anabolic steroids
- Corticosteroids
  - From adrenal cortex
  - Cortisol (antiinflammatory)
- Mineralocorticoids
  - Aldosterone (preserves Na^{+})
  - Calcitriol (active form of Vit. D; from kidneys, absorbs Ca^{2+})

Anabolic Steroids

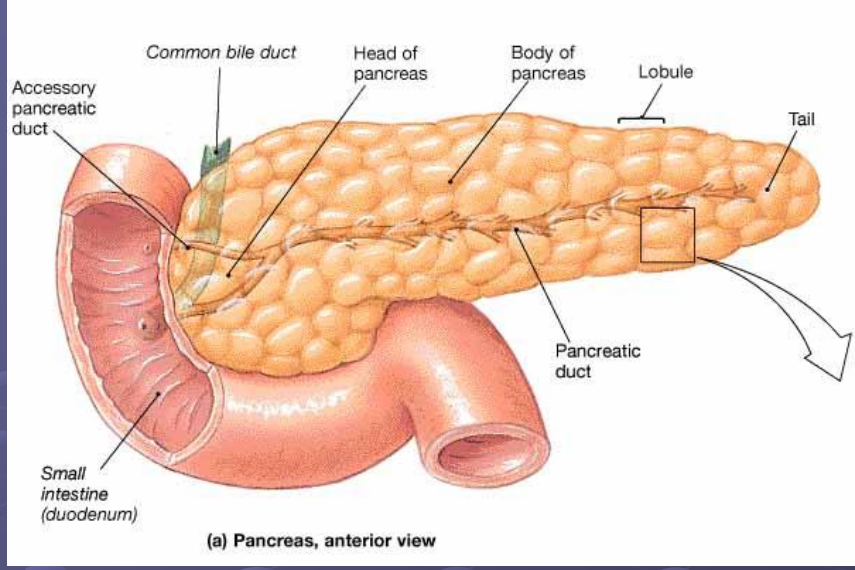
- Fluoxymesterone brand name Halotestin, Oxandrolone brand name Anavar, Methandrostenolone brand name Dianabol, Methyltestosterone brand name Metandren Oreton Methyl, Nandrolone Decanoate brand name Deca-Durabolin, Testosterone Propionate brand name Testex, Testosterone Cypionate brand name Depo-Testosterone, Stanozolol brand name Winstrol, Testolactone brand name Teslac, Dromostanolone Propionate brand name Drolban, Nandrolone Phenpropionate brand name Durabolin, Testosterone Enanthate brand name Delatestryl, Ethylestrenol brand name Maxibolin, Danazol brand name Danocrine, Calusterone brand name Methosarb, Testosterone Undecanoate, Testosterone Cyclohexanecarboxylate, Dihydrotestosterone, Methenolone Acetate brand name Primobolan, Testosterone-trans-4-n-butylcyclohexyl-carboxylate code name 20Aet-1

Pineal gland

- Part of epithalamus
- Secretes melatonin
  - Derivative of serotonin
  - Regulates circadian Rhythms (sleep cycle)
  - Inhibits hypothalamic releasing factors
    - Decreases repro function

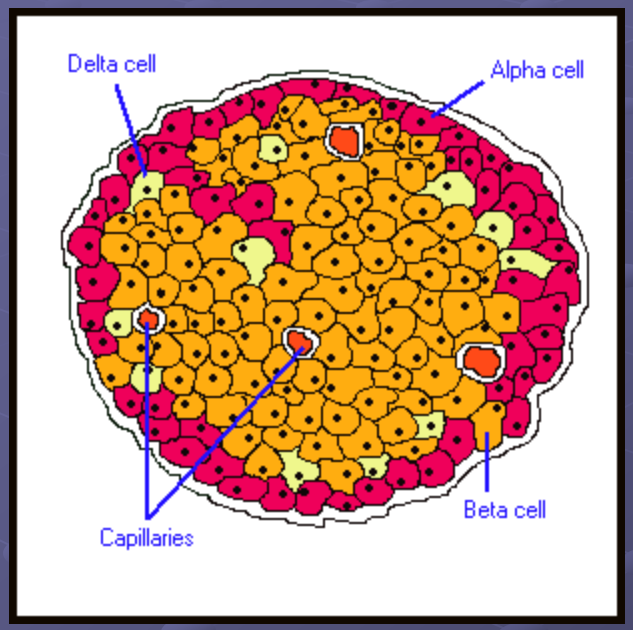


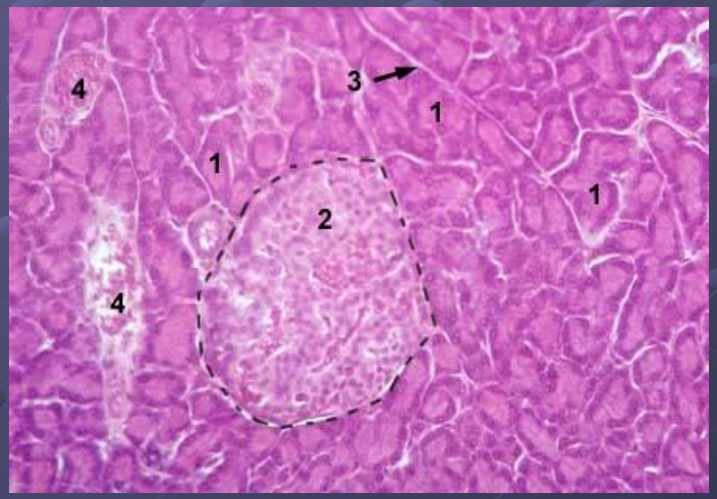
Pancreas

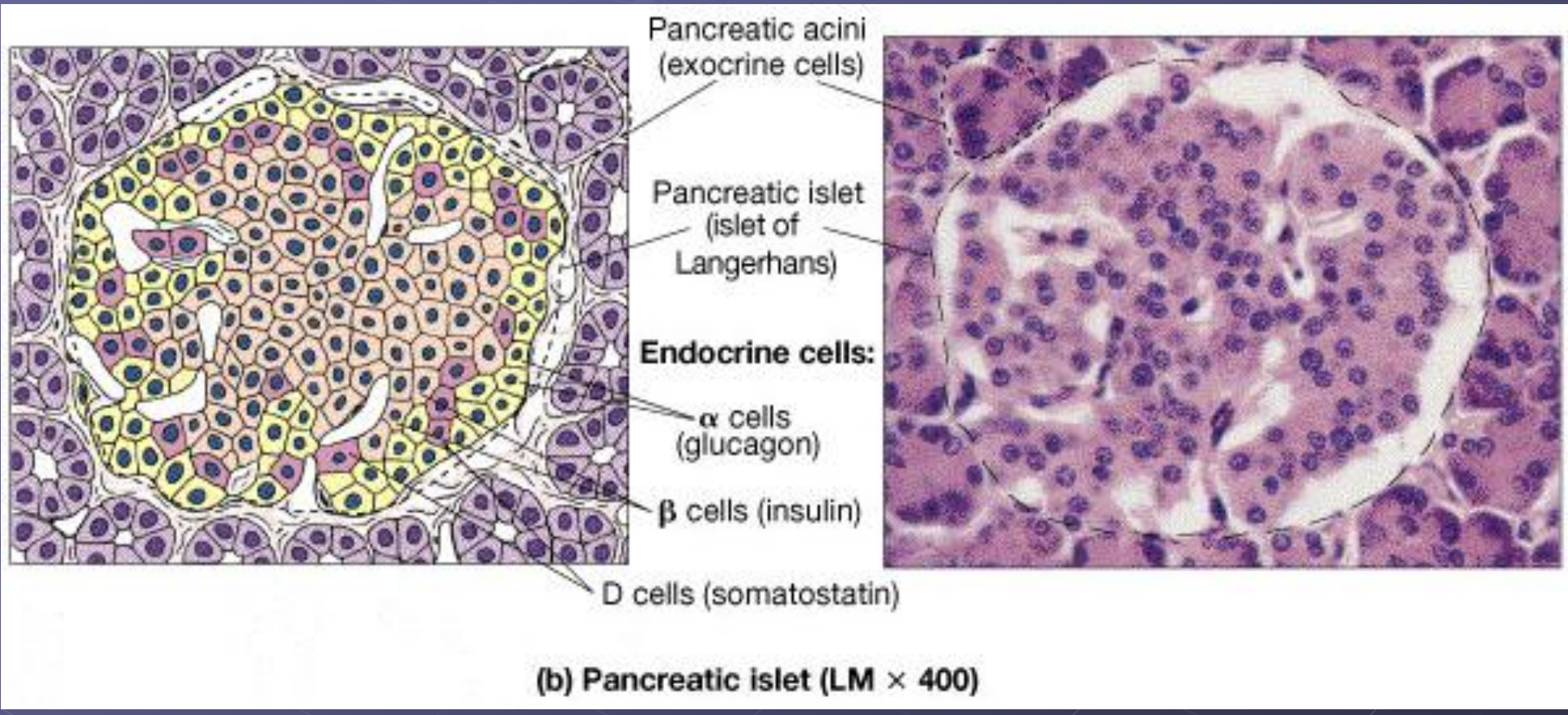


- Endocrine AND exocrine functions
  - Exocrine portion covered in Digestive System
- Pancreatic islets or Islets of Langerhans (1 x 10^6 islets)
  - α cells: glucagon ($\uparrow$ blood sugar levels by stimulating liver to convert glycogen to glucose)
  - β cells: insulin (51 a.a.) ($\downarrow$ blood sugar levels by causing the cells to take up glucose for use by the mitochondria)
  - δ (delta) cells: somatostatin
  - F cells: pancreatic polypeptide

Pancreatic Islet







(b) Pancreatic islet (LM × 400)

Diabetes

- Diabetes mellitus
  - Type 1:
    - AKA IDDM, juvenile onset
    - Deficiency of insulin
  - Type 2 (90% of DM)
    - AKA NIDDM, adult onset
    - Decreased production of insulin AND/OR
    - some sort of deficiency in receptors (insulin resistance)
    - Related to obesity, lack of exercise, age
    - Often controlled by diet, oral hypoglycemics
- Diabetes insipidus
  - Deficiency of ADH
  - Much less common

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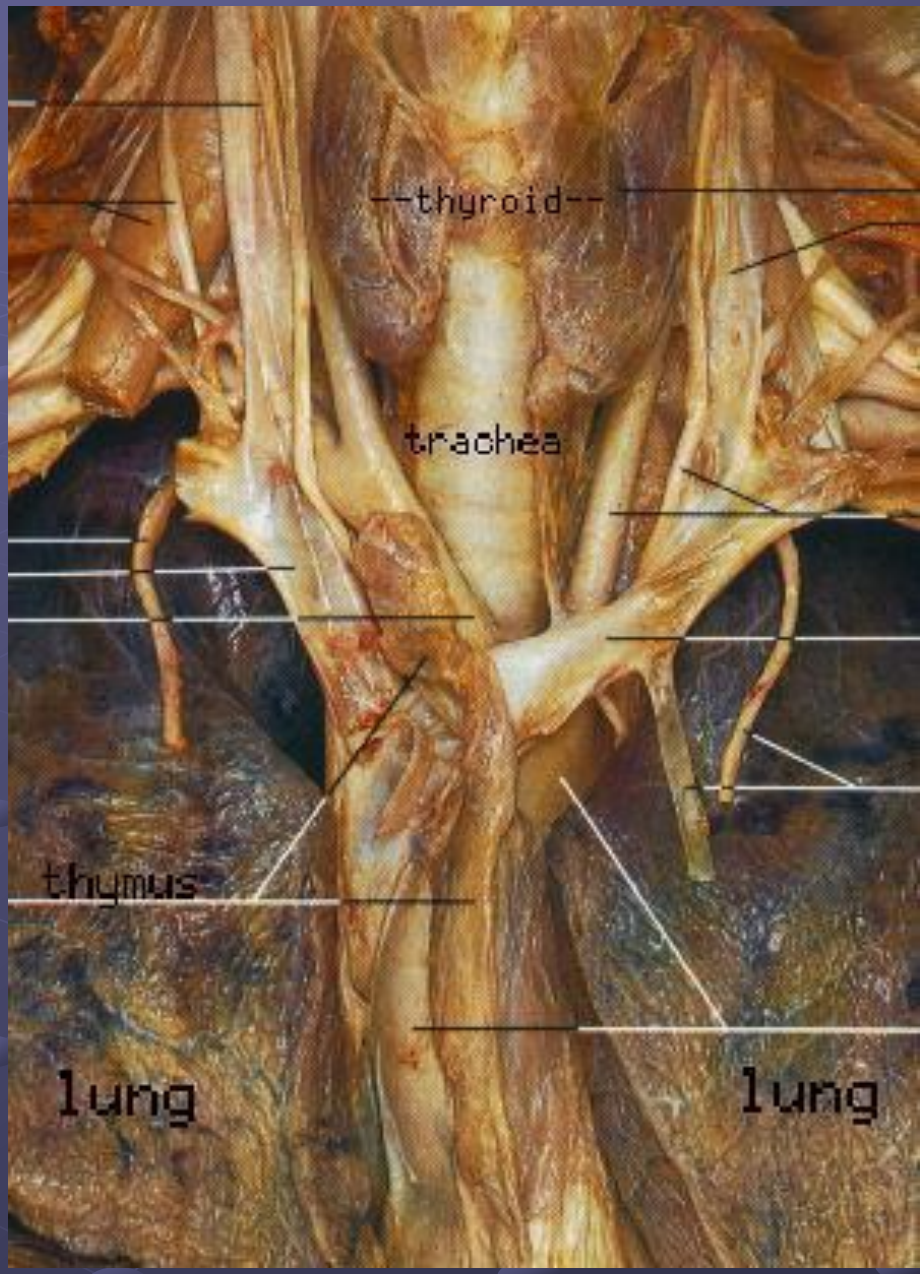
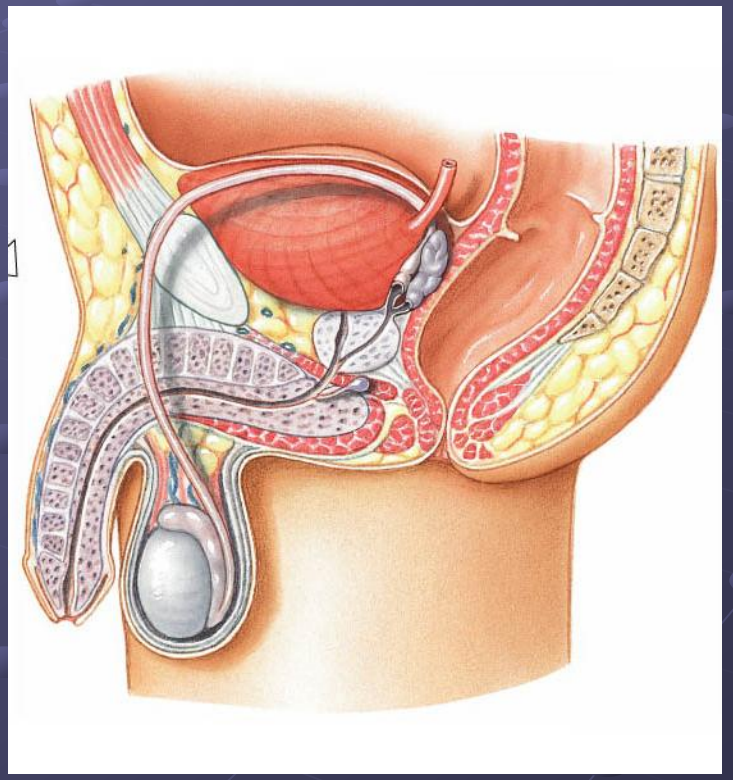
Thymus Gland

- Inside thoracic cavity immediately posterior to sternum above the heart
- Most active in infancy and childhood - Largest just before puberty, then atrophies
- Thymosin - enhances T-lymphocyte production and competence. (important for immune system development)



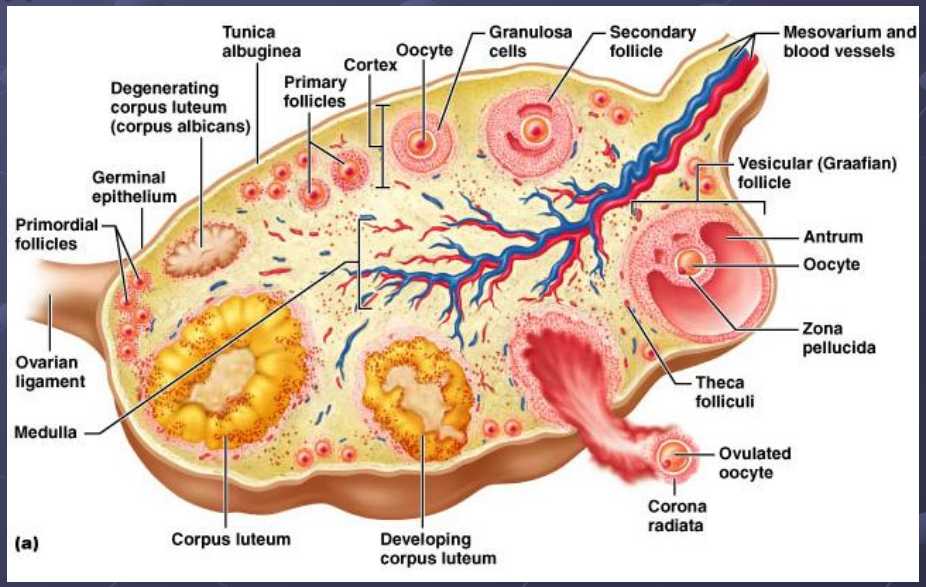
Testes

- Secrete testosterone into the bloodstream
  - From interstitial cells
  - Stimulates sperm production (along with FSH)
  - Secondary sex characteristics
- Inhibin (balances FSH)
  - From sustentacular (Sertoli) cells
- Other minor secretions



Ovaries

- Estrogen—by ovarian follicles in response to FSH
- Progesterone—by the corpus luteum (pl. corpora lutea) in response to LH
- Inhibin—decreases estrogen prod'n



Other Endocrine Structures p 529

- Heart: Atrial Natriuretic Peptide
- Brain: Brain Natriuretic Peptide
- GI Tract: Enteroendocrine cells regulate digestive processes
- Stomach: Ghrelin (not in book!)
- Adipose: Leptin, antagonist to ghrelin

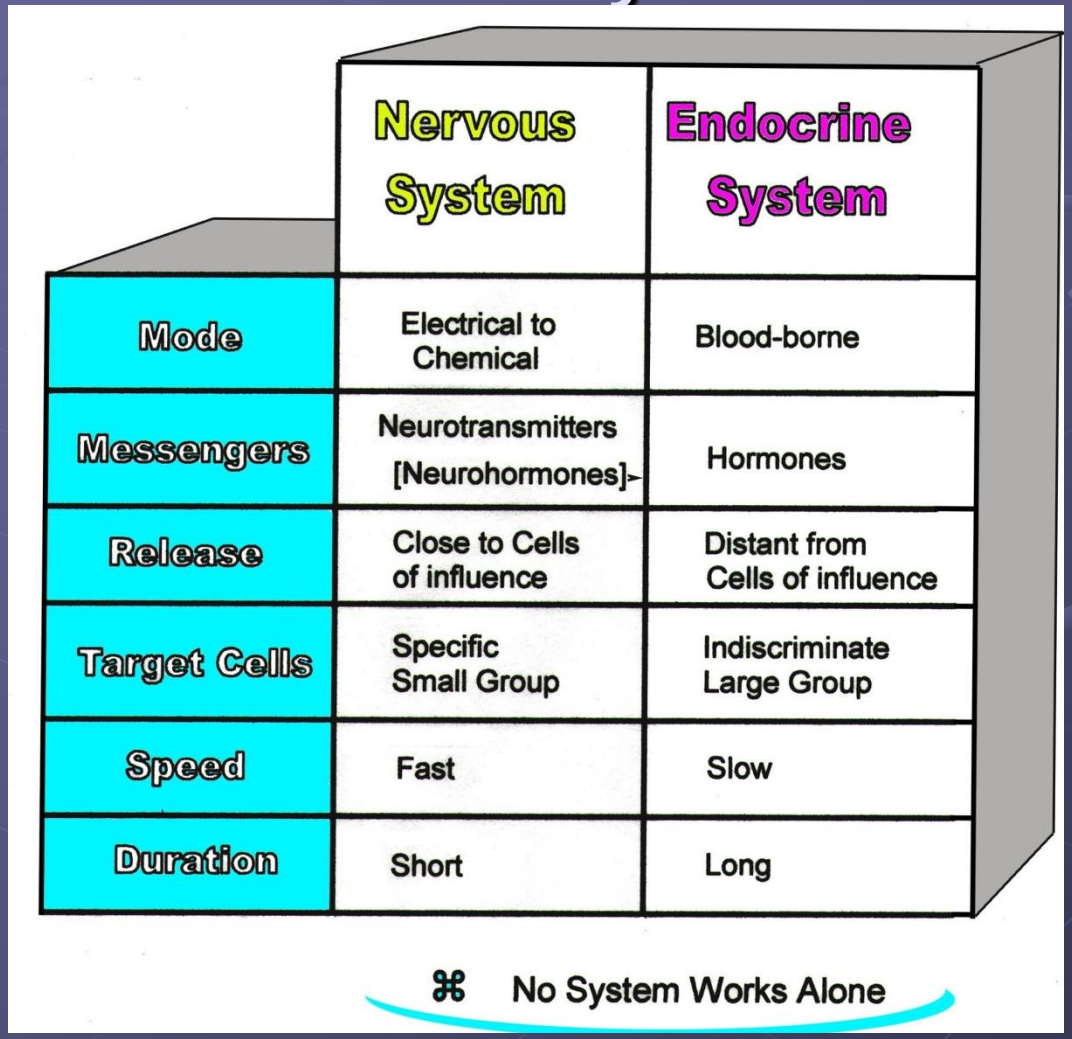
Other Endocrine Structures p 529

- Kidneys:
  - Renin: converts angiotensin to angiotensin I
    - Regulates BP
  - Erythropoietin: Stimulates production of RBCs
- Skin: Precursor to Vitamin D
- Placenta: pregnancy
  - hCG
  - Progesterone
  - HPL – Human placental lactogen (increases [glucose])
  - Relaxin – relaxes pubic symphysis and cervix

Other Hormones

- Prostaglandins (not in the book)
  - Approx 12 types, similar structure, widely different functions
  - Derived from FA
  - Produced in cell membranes in most cells
    - Does not fit some definitions of “hormone”
  - Very short half-life ($t_{1/2}$)
  - Involved in inflammatory response
    - NSAIDs are prostaglandin inhibitors
- Gastrin—produce gastric HCl
- Human Chorionic Gonadotropin (HCG)
- Endorphins
- Others yet to be discovered

Compare Endocrine and Nervous Systems



	Nervous System	Endocrine System
Mode	Electrical to Chemical	Blood-borne
Messengers	Neurotransmitters [Neurohormones]	Hormones
Release	Close to Cells of influence	Distant from Cells of influence
Target Cells	Specific Small Group	Indiscriminate Large Group
Speed	Fast	Slow
Duration	Short	Long

⌘ No System Works Alone

Hybrids = Neuroendocrine Organs